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ABSTRACT

Two factors of predicted learning disorders were investigated: (1) inability to maintain appropriate classroom behavior (BEH), (2) perceptual discrimination deficit (PERC). Three groups of first-graders (BEH, PERC, normal control) were administered measures of impulse control, distractability, auditory discrimination, and visual discrimination. Results verified that BEH children were impulsive and distractable, while PERC children lacked discrimination skills. Half of the BEH and PERC groups received attentional training, while the other half received perceptual training. Both groups then participated in a discrimination learning experiment. Results showed a significant GROUP x TRAINING interaction and significant improvement for the BEH group with attentional training. (Author)

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Factors of Predicted Learning Disorders and Their Interaction with Attentional and Perceptual Training Procedures

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The present study provides additional evidence bearing on the validity of two independent factors of learning disorders in young children. One factor relates to a child's ability to maintain appropriate classroom behavior; and the other factor is based on the child's perceptual discrimination ability. Previously, it was found that children rated by their kindergarten teachers as showing deficits on these particular factors, later showed deficits on certain experimental measures administered in the first grade (Friar, 1972). Specifically, a group of children who were predicted to have learning disorders and who were also rated by their kindergarten teachers as showing an inability to maintain appropriate classroom behavior, performed significantly more poorly on measures of impulse control and distractibility than other first graders; and a group of children who were predicted to have learning disorders and who were rated by their kindergarten teachers as showing a perceptual discrimination deficit, performed significantly more poorly on measures of auditory and visual discrimination than other first graders. Thus, the existence of two distinct groups of children with predicted learning disorders was established: 1. a group characterized by an inability to maintain appropriate classroom behavior; and 2. a group characterized by a perceptual discrimination deficit.

Both types of deficit have been previously considered in relation to reading and learning disabilities. For example, the research on hyperactivity (eg.,Keogh, 1972) and impulsivity (e.g., Kagan, 1965; 1966) is relevant to the behavioral deficit factor; while the body of research on visual and auditory discrimination (e.g., Buktenica, 1970; Frostig, 1963; McGrady & Olson, 1971) is relevant to the perceptual discrimination factor.

The objective of the present research was to demonstrate that teaching interventions aimed at children with predicted learning disorders would be more effective if designed to deal directly with a child's specific underlying deficit. That is, an intervention aimed at helping a child who has difficulty in maintaining appropriate classroom behavior will be more effective if it is designed to deal specifically with that behavioral deficiency; and, similarly, an intervention aimed at helping a child who has a perceptual discrimination deficit will be more effective if it is designed to deal specifically with that perceptual deficit. To demonstrate the differential effects of teaching interventions, two groups of children who were predicted to have learning disorders participated in a discrimination learning experiment: 1. a group characterized by a deficit on the classroom behavior factor (BEH group); and 2. a group characterized by a deficit in perceptual discrimination (PERC group). Two models of teaching intervention were used: one was attention training designed to benefit the BEH group; and the other was perceptual discrimination training designed to benefit the PERC group. The attention training was a vigilance task in which the child was reinforced for maintaining attention; the discrimination training reinforced the child for detecting distinctive features of visual stimuli. Half of each group received each type of training. It was hypothesized that performance on the discrimination learning task would be better for those children who received training designed to deal with their specific disability.

Specifically, the hypothesis is that in the discrimination learning experiment , there is an interaction of Diagnostic Group X

Type of Training. Thus, the BEH group performs better after training for attention than after training for discrimination; and the PERC group performs better after training for discrimination than after training for attention.

METHOD

Sample. Approximately 800 kindergarten children were administered three instruments. Two instruments, the Kohn Social Competence Scale (Kohn & Silverman, 1966) and the DeHirsch Predictive Index (DeHirsch, Jansky, & Langford, 1966), were used to define a subgroup of children who would be predicted to show later reading or learning disabilities. Children having a score of 4 or less on the DeHirsch Predictive Index or who scored in the bottom 10% of their classroom on the Kohn Social Competence Scale -- Factor I (Interest-Participation vs. Apathy-Withdrawal) formed this high-risk subgroup. On the basis of a Student Rating Scale completed by each child's kindergarten teacher, two subgroups were defined within this high-risk subgroup:1. a group characterized by the classroom behavior deficit (BEH group); and 2. a group characterized by a perceptual discrimination deficit (PERC group). The Student Rating Scale, administered in connection with an extensive study of early identification of children with reading problems, yields factor scores on both the behavioral and the perceptual factors. Specifically, the twenty high-risk children who had the greatest difference in their behavioral minus perceptual factor scores were included in the BEH group; while the twenty children who had the greatest difference in their perceptual minus behavioral factor scores were included in the PERC group. Randomly, the children in each of these groups were assigned to an attention training or to a discrimination training condition.

Procedure.

Attention pretraining was designed to enhance sustained selective attention, cooperation, and impulse control. Half of the BEH and half of the PERC groups received this pretraining. The pretraining lasted for 10 minutes on the first day of the study, and for the initial five minutes of the second day of the study. The pretraining required the child to sit and observe a display board with two lights on it. One light was clearly indicated by arrows as the target light and the other was a distractor light. The two lights were $1\frac{1}{2}$ inches apart and the child had to be attending carefully to discriminate which light was on. The child was told that if the target light came on, he was to say "light," and otherwise he was to say nothing and to continue to watch for the target light. At the outset, the child was told that during this game he would be able to earn tokens, and that he could trade his tokens in for a prize at the end of the day. The only way he could earn a token was to correctly report the target light coming on. When he did correctly report the target light, he received a token immediately. The target light came on once during every thirty second interval of pretraining; the exact time of onset was randomized. The duration of both lights was about one second. The child was given feedback when he: 1. correctly reported a light (he was given a token and told "good"); 2. incorrectly reported a light (he was told, "No, there wasn't one."); and 3. failed to report a light (he was told, "You missed one."). All children traded their tokens in for a prize at the end of the first day, and, at the end of pretraining on the second day, the tokens for that second day were counted and then the

child was told that if he did well on the final game (discrimination learning task), he would receive another prize. The prizes were items such as crayons, inexpensive books, rulers, and coloring books.

Discrimination Pretraining

The contrasting experimental condition of discrimination pretraining was designed to improve visual discrimination ability. The children in the BEH and PERC groups who did not receive attention pretraining received this pretraining. The pretraining was based on Gibson's principles of perceptual learning. She states, "Discrimination learning should be facilitated when distinctive feature differences (or differential properties) are emphasized in training." (1966, p. 99) The discrimination pretraining was designed to teach the child to look for distinctive features of stimuli. Each child was shown sets of four stimuli in which three were the same and one was different. The child was asked to point out which stimulus was different from the others, and then he was asked what the distinctive feature was that made it different. Each set of four stimuli varied on the basis of only one distinctive feature (e.g., size, left-right reversal, upside down), and the sets were designed to become somewhat more difficult as the pretraining continued. If the child correctly pointed to the different stimulus of the set, he received a token and was asked to indicate the distinctive feature difference. If the child was incorrect or unable to make a response, the correct stimulus was pointed out and the distinctive feature was explained to him (e.g., "This one is different. See, it is upside down and the others are rightside up."). Discrimination pretraining also lasted for ten minutes on the first day and for five minutes on the second. Children receiving discrimination pretraining received a prize at the end of the first day. On the second

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day their tokens were counted and they were told that if they did well on the final task they would receive another prize. The prizes were the same as those offered children receiving attention training.

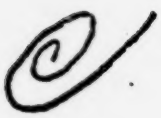
Visual Discrimination Learning Experiment

The primary dependent measure was the child's performance in a visual discrimination learning task administered on the second day of the study, after the second pretraining session. This experiment was an identification experiment as defined by Gibson, "An identification experiment differs from a detection, a discrimination, or a recognition experiment in that a unique response of the subject is required for each item presented. ... There must be established a one-to-one correspondence between a set of items and a set of responses." (1966, p.180). Thus, this experiment was like a paired associates learning task. The stimuli were designs (see Fig. 1) and the responses were the numbers one through six. These simple responses were used to essentially eliminate the response learning phase of the task. All children received alternating learning and test trials, and continued until they completed three consecutive, errorless trials or until they completed a total of 20 test trials. During each learning trial, the child was shown each stimulus card for five seconds, while the E told him the correct number of the card twice. During the test trials, the child was again shown each stimulus card for up to five seconds, as he was asked to tell the E the correct number. The children understood that it was all right to guess if they were not sure of the correct answer. The stimulus cards were presented in random order for both learning and test trials. There was a ten

Figure 1

Stimuli Used in Visual Discrimination Learning Experiment

(Actual Size)

1 

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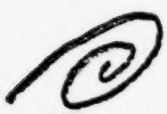
5 

3

6

second inter-trial interval.

All children received the same instructions. They were told that if they did well, they would be able to win another prize after they finished the learning game. They were told that they would be shown some designs, that each design had a number that went with it, and that their job was to learn the number that went with each design.

RESULTS

The measure of learning task performance was the total number of errors made during the 20 test trials. Both a failure to respond and an incorrect response were scored as an error. It should be noted that after completing three, consecutive, errorless trials, a child was given credit for zero errors on any remaining trials.

A 2 X 2 analysis of variance was performed on the total error data. Neither Training main effects (F=.24; df=1,36) nor Group main effects (F=1.09; df=1,36) were statistically significant. As predicted, the Training X Group interaction was significant (F=8.01; df=1,36; p<.01). Since the interaction was significant, an analysis of the simple effects was appropriate. Analyzing the simple effects by Group, the PERC group, as predicted, made fewer errors after discrimination training than after attentional training (F=5.53; df=1,36; p<.05); and the BEH group showed a nonsignificant trend in the opposite direction (F=2.73; df=1,36; p<.15). Analyzing the simple effects by Training, the attention training was significantly more effective for the BEH group than for the PERC group (F=7.50; df=1,36; p<.01); and the discrimination training showed a slight nonsignificant tendency to be more effective for the PERC than for the BEH group (F=1.60; df=1,36; p<.20). The total

Table 1

Discrimination Learning Experiment:

Mean Total Errors for BEH and PERC groups (N=20 per group)

Group	Pretraining			
	Attentional		Discrimination	
	Mean	(S.D.)	Mean	(S.D.)
BEH	23.60	(13.68)	41.50	(31.81)
PERC	53.30	(30.67)	27.80	(14.52)

Table 2

Discrimination Learning Experiment:

Analysis of Variance of Total Errors for BEH and PERC Groups

(N=20 per group)

Source	df	Mean Square	F	p
Pretraining Meth.	1	144.4	.24	
Group	1	640.0	1.09	
Pretrain. X Group	1	4708.9	8.01	.01
Within Cells	36	587.7		
Simple Effects of Pretraining				
For BEH group	1	1602.0	2.73	
For PERC group	1	3251.2	5.53	.05
Within Cells	36	587.7		
Simple Effects of Group				
Attentional	1	4410.4	7.50	.01
Discrimination	1	938.4	1.60	
Within Cells	36	587.7		

Table 3

Discrimination Learning Experiment:

Proportion of Groups Attaining Criterion (N=10 per cell)

Group	Pretraining	
	Attentional	Discrimination
BEH	.90*+	.40 +
PERC	.30* #	.80 #

* Significant difference: $\underline{X}^2=5.21$, $\underline{df}=1$, $\underline{p}<.025$

+ Trend: $\underline{X}^2=3.52$, $\underline{df}=1$, $\underline{p}<.10$

Trend: $\underline{X}^2=3.23$, $\underline{df}=1$, $\underline{p}<.10$

mean errors for the four groups appear in Table 1 and the complete analysis of variance appears in Table 2.

Comparing the proportion of children in each group who achieved the criterion of three, completely correct trials within the twenty test trials, provides another opportunity for looking at the simple effects of Training and Group. Looking at the proportion by Group, in the BEH group there was a trend indicating that more children attained criterion after attentional training than after discrimination training. ($\underline{X}^2$=3.52; $\underline{df}$=1; $\underline{p}$<.10); and in the PERC group, there was a trend indicating that more children attained criterion after discrimination training than after attentional training ($\underline{X}^2$3.23, $\underline{df}$=1; $\underline{p}$<.10). Looking at the proportions for each training method, attentional training resulted in a significantly greater proportion of BEH children attaining criterion than PERC children ($\underline{X}^2$5.21; $\underline{df}$=1; $\underline{p}$<.025); and perceptual training showed a nonsignificant trend in the opposite direction ($\underline{X}^2$=1.88; $\underline{df}$=1). The proportion of each group who attained criterion is listed in Table 3.

Summarizing the results for this visual discrimination learning experiment: 1. there was a significant interaction between Group and Training; 2. Attentional training resulted in better performance for BEH as compared to PERC children, while discrimination training showed a nonsignificant trend in the opposite direction; 3. The PERC group performed significantly better after discrimination training than after attentional training, while the BEH group showed a nonsignificant trend in the opposite direction.

DISCUSSION

It is encouraging to note that such limited interventions as

were used in this experiment actually resulted in a significant interaction of type of intervention by diagnostic subcategory of predicted learning disorder. The total duration of pretraining for the child was only 15 minutes for both types of training; yet, if the training was geared to the child's specific deficit, it was effective in improving learning performance as compared to pretraining not geared to his specific deficit.

Indirectly, these results also give support to Gibson's (1966) notion that teaching a child to look for distinctive features in stimuli can improve his discrimination ability. Also, these results indirectly support that through positive reinforcement, a child's pattern for maintaining selective attention can be modified.

One general implication of the research is that the general category, learning disorder, connoting a unitary group, may tend to confuse or complicate our understanding of these types of deficits. It is unfortunately too common that children with learning disorders, or predicted learning disorders, are placed in a common program without regard for their specific type of underlying deficit; in fact, often without knowledge of their underlying deficits. As shown by this research, one result of this lack of specification can be that an intervention which is very helpful for some children may be relatively ineffective with others. Ineffective interventions can only waste children's and teachers' time and patience and lead to frustration for both. Interventions which are specifically designed to alleviate a child's underlying deficit may provide a way for helping high risk children succeed. When working with children who have learning disorders, it becomes very important to diagnose deficits and to individualize each child's classroom program to meet his specific needs. The present results

indicate that two fruitful areas of individualization to pursue are attention and perceptual discrimination training. Both, when administered to a child with the appropriate deficit, can significantly improve performance on a perceptual learning task. Additional research may reflect a similar utility for such individualized approaches when reading tasks are employed.

Further, the research indicates that improving a child's learning performance can be approached effectively by working with underlying deficits. For the PERC group children, it is possible that the perceptual discrimination deficit could lead to learning problems in a variety of areas (e.g., reading, spelling, arithmetic, art, music). This research showed that perceptual discrimination training improved learning performance on one learning task. It is likely that improved discrimination ability would help PERC children improve their performance in a wide variety of academic areas.

Similarly, the children in the BEH group could also show a deficit in a wide variety of academic areas due to their poor work habits, distractibility, etc. This research indicated a trend showing that training BEH children to maintain selective attention improved their performance on one learning task. Since attention is vital to all types of learning, it seems likely that improved attention habits could help BEH group children with all types of academic material. Thus, for the BEH group, too, working with the underlying deficit may be more efficient than remediation or special work in specific academic areas.

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